

A NEW TURTLE SKULL FROM THE PURBECKIAN OF ENGLAND AND A NOTE ON THE EARLY DICHOTOMIES OF CRYPTODIRE TURTLES

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ABSTRACT. A new cryptodire turtle skull, *Dorsetochelys delairi*, is described from the Purbeckian of Dorset. It possesses features of both the Glyptopidae and the Baenidae, but cannot be accommodated satisfactorily in either of these two families. Early dichotomies of the cryptodires are discussed. It is concluded that the family Glyptopidae is the sister group of all other forms, and that only subsequently did the Baenidae diverge from the typical cryptodires, which include the modern forms.

THE specimen described in this paper is a complete skull lacking all traces of lower jaws and postcranial skeleton, which belongs to the Dorset County Museum in Dorchester. It came to our attention as a result of a reference to it by Delair (1958), who stated that Smith Woodward referred it to the genus *Pleurosternum* in 1909 on the basis of the ornamentation of the skull, which resembles the shell ornament of that genus.

There are seven turtle genera known from the Purbeckian of Dorset (Lydekker 1889; Delair 1958). All lack skulls, and several of these cannot be distinguished from one another on dermal ornament alone. On the other hand, there are now two skulls, *Mesochelys* (Evans and Kemp 1975) and the present specimen which, although quite different from one another, cannot be distinguished on the cranial ornament alone. At the present time, therefore, it is impossible to identify this new skull as belonging to a genus based on the shell. Though it may eventually prove to belong to an existing genus currently based on postcranial remains, we cannot at the present time be certain of this, and we have therefore decided to name and diagnose it now, as a new genus and species, for immediate scientific convenience.

Before preparation the skull was only exposed dorsally. The matrix is a hard, buff limestone, and complete preparation by the acetic acid method has exposed the palatal surface. It is severely but symmetrically crushed dorso-ventrally, and the anterior part of the palate is slightly damaged. Less reliance can be placed on dorso-ventral dimensions of the reconstruction than on others.

SYSTEMATIC PALAEOLOGY

The specimen corresponds in skull structure to the primitive cryptodire superfamily Baenoidea as defined by Gaffney (1972), in possessing nasal bones; prefrontals not meeting in the midline; foramen posterior canalis carotici interni opening midway along the basisphenoid-pterygoid suture. However, it shows a mosaic of features of

the two families, Glyptopidae and Baenidae, that Gaffney placed in the Baenoidea. Glyptopid characters are the dorsal exposure of the prefrontal; limited posterior emargination of the skull roof; ossified epipterygoid. Baenid characters are the failure of the basisphenoid to extend for the full length of the pterygoids; wider triturating surface to which the palatine contributes significantly; greater postero-medial extent of the pterygoid, flooring the cavum acustico-jugularis and making a relatively long suture with the basioccipital. As discussed later, this new form cannot be incorporated satisfactorily in either of these two families in a strictly monophyletic sense.

Dorsetochelys gen. nov.

Type species. *D. delairi* sp. nov.

Diagnosis. Primitive cryptodire with the skull slightly longer than wide; very little posterior emargination; parietal meeting squamosal in a long suture; nasals large; prefrontal with moderate dorsal exposure; basisphenoid long but not extending for the full length of the pterygoids; ossified epipterygoid; palatine makes substantial contribution to the triturating surface; dorsal triangular exposure of the supra-occipital between the parietals.

Dorsetochelys delairi sp. nov.

Text-figs. 1-2

Diagnosis. As for genus.

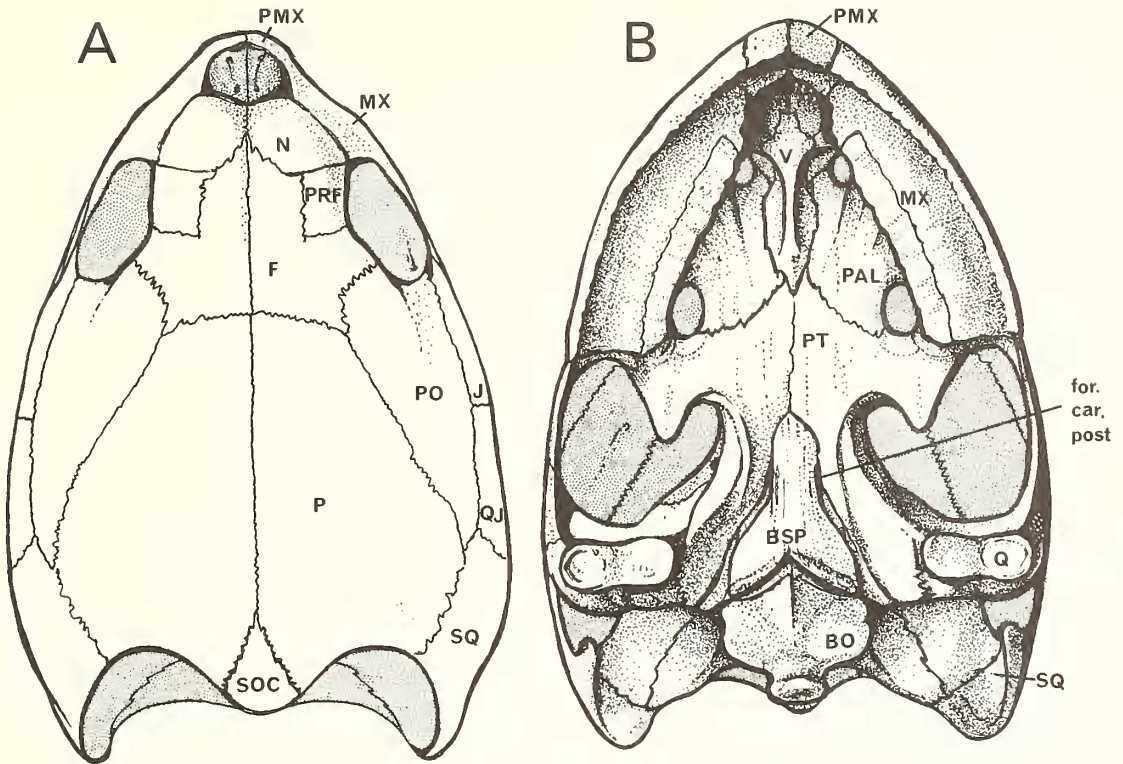
Holotype. Dorset County Museum, Dorchester. Spec. no. G23. Skull lacking lower jaws.

Locality. Swanage, Dorset.

Horizon. Purbeckian, Lower Cretaceous.

Description. The precise original shape of the skull is not certain because of the extensive dorso-ventral distortion, but it seems to have been almost oval in dorsal view with the length exceeding the maximum breadth. The lateral profile was rather low. There is a relatively very small degree of emargination of the posterior border of the skull roof, and the foramen stapedio-temporale is not visible from above. There is an equally slight degree of emargination of the ventro-lateral skull margin.

The sutural pattern on the dorsal surface of the skull is clear from text-fig. 1A. The relatively large size of the nasals is notable; they meet the frontals in an oblique suture reminiscent of the condition in *Mesochelys* (Evans and Kemp 1975). The dorsal exposure of the prefrontal is similar to that of typical reptiles, being neither expanded to the midline as in most cryptodires, nor reduced as in typical baenids. A typically cryptodire antero-ventral process of the prefrontal descends, in contact with the maxilla, to meet the dorsal surface of the palate and form the anterior wall of the orbit. The suture between the maxilla and the nasal is straight and horizontal, and closely resembles the condition in the primitive baenid *Trinitichelys* (Gaffney 1972). The very extensive sutural contact between the squamosal and the parietal is correlated with the low degree of emargination of the posterior part of the skull. A peculiar feature of the posterior part of the skull roof is a broad triangular exposure



TEXT-FIG. 1. *Dorsetochelys delairi*. A, skull in dorsal view, $\times 1$. B, skull in ventral view, $\times 1$.

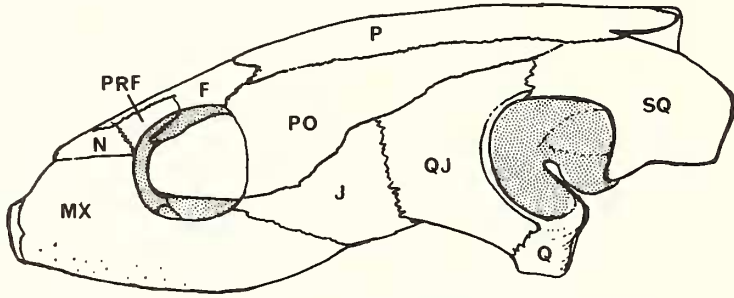
Abbreviations: BO, basioccipital; BSP, basisphenoid; F, frontal; for. car. post, foramen posterior canalis carotici interni; J, jugal; MX, maxilla; N, nasal; P, parietal; PAL, palatine; PMX, premaxilla; PO, postorbital; PRF, prefrontal; PT, pterygoid; Q, quadrate; QJ, quadratojugal; SOC, supraoccipital; SQ, squamosal; V, vomer.

of the supraoccipital between the hind ends of the paired parietals. The surface texture of this part of the supraoccipital is preserved, indicating that its exposure is not the result of damage to the bones in the area. There is no posterior extension of a supraoccipital crest and, although apparently undamaged, this condition may have resulted from the crushing of the skull.

In ventral view, text-fig. 1B, the palate is broad and flat, with very little vaulting between the triturating surfaces. The triturating surface itself is fairly broad and it widens slightly posteriorly. The extent to which the palatine contributes is unusual, and there is a deep, sharp labial ridge along the external margin, but no tomial ridge is developed. The paired pterygoids meet in the midline and contact the vomer anteriorly, separating the palatines from one another. The basisphenoid is much shorter than the pterygoids but is still relatively long, and there is no sign of a specific basiptyergoid articulation as there is in *Mesochelys*. The posterior foramen for the internal carotid artery lies rather forward of the midway point of the basisphenoid, and the canal disappears anteriorly into the bone. A distinct groove runs backwards from the foramen along the lateral edge of the basisphenoid, and then postero-laterally

across the pterygoid to the hind edge; this must have carried the internal carotid artery. Enclosure of this groove ventrally would correspond to the typical cryptodire condition, in which the carotid canal opens more posteriorly. Behind the basisphenoid there is a relatively extensive contact between the pterygoid and the basioccipital; this is because the pterygoid extends further medially than in *Mesochelys* and *Glyptops*.

A large epipterygoid is present, its base lying against the lateral edge of the pterygoid flange of the palate.



TEXT-FIG. 2. *Dorsetochelys delairi*. Skull in lateral view, $\times 1$.

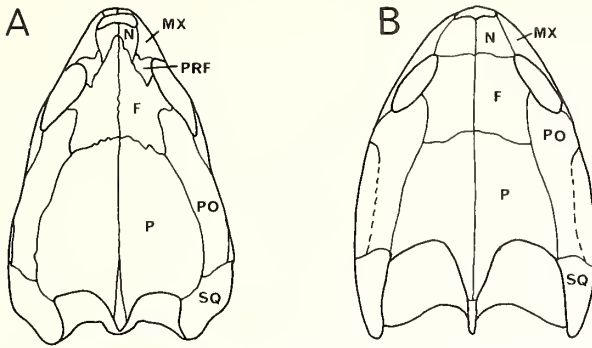
The extensive dorso-ventral crushing has badly distorted the occiput, but it appears to be of standard chelonian form. Two foramina nervi hypoglossi emerge through the ventro-medial part of the exoccipital bone, the posterior one being considerably larger than the anterior one.

Both the quadrates are crushed, but it is clear that the stapedia notch is open posteriorly and that there was a normally developed antrum postoticum.

DISCUSSION

The cranial anatomy of all the better-known Upper Jurassic and Lower Cretaceous turtles indicates that they are members of the Suborder Cryptodira, despite the absence of the characteristic postcranial modifications of the modern members of the group, and they should no longer be retained in Lydekker's suborder 'Amphichelydia' (see Gaffney 1972; Evans and Kemp 1975). These remarks apply equally to *Dorsetochelys*. Interpretation of the interrelationships of these early forms is difficult, because all of them have achieved an essentially modern cranial morphology which tends to mask the differences which do exist between them. Nevertheless, there appear to be three characters of particular significance:

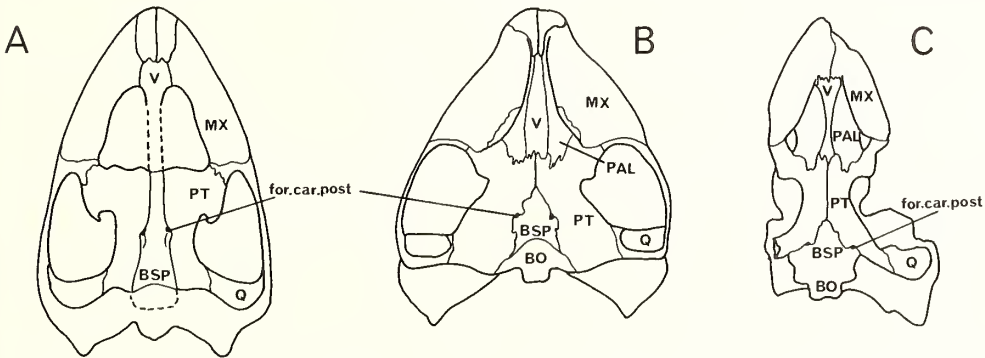
1. Condition of the prefrontal bones (text-fig. 3). The ancestral condition is surely that of a moderate dorsal exposure as found in the glyptopids *Glyptops* (Gaffney 1972) and *Mesochelys* (Evans and Kemp 1975) and in *Rhinochelys* from the Cambridge Greensand (Collins 1970), because of its close resemblance to the standard reptilian form. Two derived conditions are reduction of the dorsal exposure as in the baenids (Gaffney 1972), and expansion of the dorsal lappet to meet its fellow in the midline as in most other cryptodires. In this respect *Dorsetochelys* has retained the ancestral type of prefrontal.



TEXT-FIG. 3. Dorsal views of the skulls of A, *Mesochelys* (glyptopid); B, *Trititichelys* (baenid). (A, after Evans and Kemp 1975; B, after Gaffney 1972.)

2. Position of the foramen posterior canalis carotici interni (text-fig. 4). In the glyptopids, baenids and also *Dorsetochelys*, this lies anteriorly, half-way along the suture between the basisphenoid and pterygoid bones. In all other known cryptodires it lies posteriorly, near the hind border of the skull. Gaffney has argued that both these conditions are derived from an as yet unknown ancestral position of the foramen. However, there appear to be good grounds for considering the anterior position to be ancestral to the posterior position, because the former approximates to the position of the foramen in typical reptiles. Furthermore, in *Mesochelys* the foramen is intimately associated with a very primitive arrangement of the basiptyergoid articulation whereby the remnant of the reptilian basiptyergoid process of the basisphenoid is still discernible (Evans and Kemp 1975). Furthermore, *Dorsetochelys* indicates how the posterior position of the foramen might readily be derived from the anterior position by a roofing over of the groove leading backwards from the foramen to the hind border of the skull.

3. The relative midline length of the basisphenoid (text-fig. 4). In the glyptopids, the basisphenoid extends anteriorly to reach the vomer and thus separates the



TEXT-FIG. 4. Ventral views of the skulls of A, *Mesochelys* (glyptopid); B, *Eubaena* (baenid); C, the 'Portland' skull ('typical cryptodire'). (A, after Evans and Kemp 1975; B, after Gaffney 1972; C, after Parsons and Williams 1961.)

pterygoids completely from one another (a similar but probably secondary condition occurs in the trionychid cryptodires). In contrast, the basisphenoid of other forms is shorter than the pterygoids, so that the latter pair of bones meet in the midline anterior to the basisphenoid. It is difficult to know which of these two conditions should be regarded as ancestral for cryptodires, but the generally primitive nature of the basisphenoid in the glyptopids in other respects suggests that it may be primitive in this respect also, in agreement with the view of Gaffney (1972).

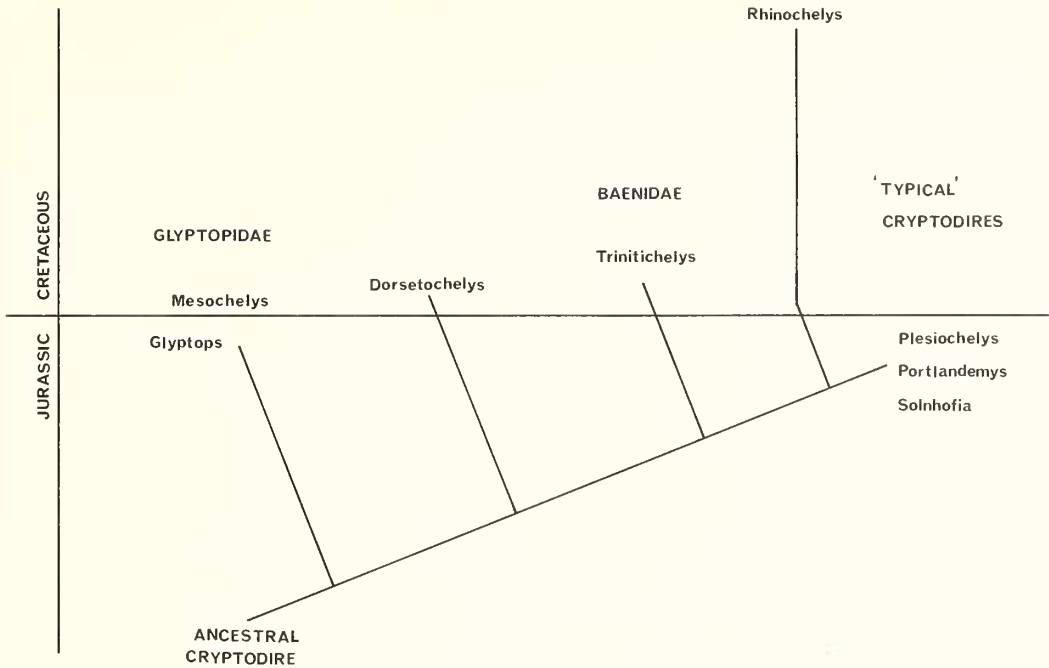
Certain other features found only in the glyptopids are probably also ancestral for the cryptodires as a whole—for example, the failure of the pterygoids completely to floor the cavum acustico-jugulare, with a correspondingly very limited contact between the pterygoid and the basioccipital, and the presence of an ossified epipterygoid. On the other hand, certain other features of members of this family, such as the elongation of the skull and the narrow triturating surfaces, are more likely to be specializations related immediately to the particular habit of the group.

The only characters which link the glyptopids with the baenids (and also with *Dorsetochelys*) are the anterior position of the carotid foramen and the absence of the expanded type of prefrontal bone. However, both are no more than ancestral cryptodire features, and therefore Gaffney's (1972, 1975b) proposed superfamily Baenoidea which consists of these two families alone is of doubtful phylogenetic validity, since they share no derived characters in common. We propose therefore that the superfamily Baenoidea should be abandoned and its constituent families Glyptopidae and Baenidae be considered separately.

Using the above key characters, and assuming that the indicated derived character states were in fact uniquely derived, the following phylogeny of early cryptodires is suggested (text-fig. 5).

The first dichotomy was between the glyptopids (*Glyptops* and *Mesochelys*) on the one hand, which retain the primitive character states except for a number of minor modifications including skull elongation, and all the remaining cryptodires on the other, which lost the remnant of the reptilian basipterygoid articulation, shortened the basisphenoid, and expanded the pterygoid postero-medially. Another major dichotomy separated the baenids, which reduced the prefrontal bones but retained the anterior position of the carotid foramen, from the rest of the known cryptodires in which the posterior position of the carotid foramen evolved. Within these remaining cryptodires, which include the Upper Jurassic *Portlandemys* (Gaffney 1975a), *Solnhofia* (Gaffney 1975b), and *Plesiochelys* (Bräm 1965; Gaffney 1975a) as well as the modern forms, the Upper Cretaceous *Rhinochelys* (Collins 1970) is unusual in retaining the primitive moderate-sized prefrontals. It is separated therefore from what might be termed the 'typical' cryptodires in which the prefrontals have expanded to meet in the midline.

Within the context of the phylogeny, the position of *Dorsetochelys* is ambiguous. It is clearly a member of the non-glyptopids but, since it lacks the derived characters of both the baenids and the 'typical' cryptodires respectively, it is not possible to know whether it separated before or after the divergence of these two groups. Its own particular specializations are relatively trivial, and include the expansion of the supraoccipital between the parietals and other details of the suture pattern of the dermal



TEXT-FIG. 5. Phylogeny of early cryptodire turtles known by their skulls.

bones. In general terms it must lie quite close to the ancestry of both the baenids and the 'typical' cryptodires. However, there is a distinct trend towards emargination of the posterior border of the skull roof within both these groups, and the absence of any such tendency in *Dorsetochelys* may be interpreted as evidence that this genus diverged before the establishment of either the baenid or the 'typical' cryptodire type of skull. By this admittedly slightly tenuous reasoning, *Dorsetochelys* is seen as a sister-group of all the other non-glyptopid cryptodires.

No formal classification of these early cryptodires is attempted on the basis of this tentative phylogeny. To judge from the number of genera known only from shell anatomy, there must be a considerable range of skulls not yet known which may ultimately radically change ideas about the evolution of the cryptodire skull.

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